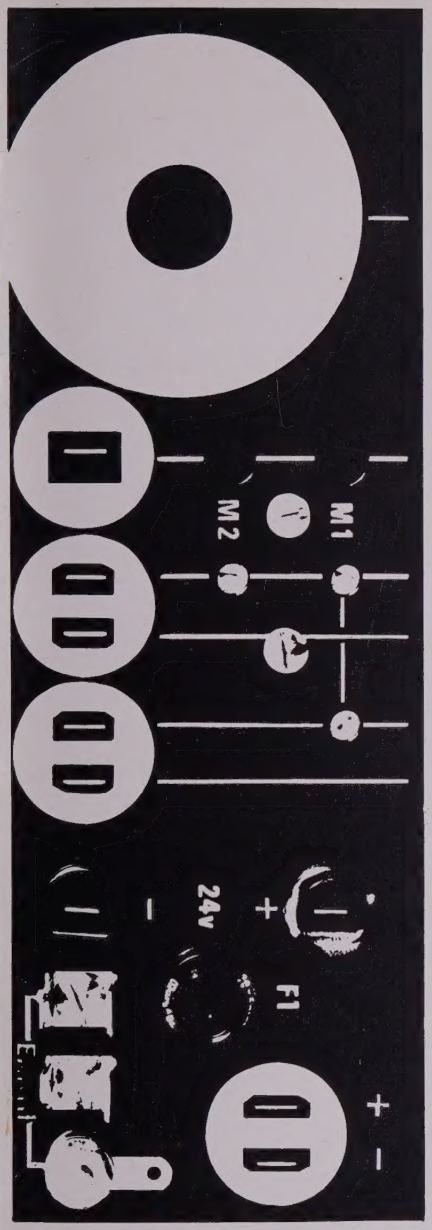
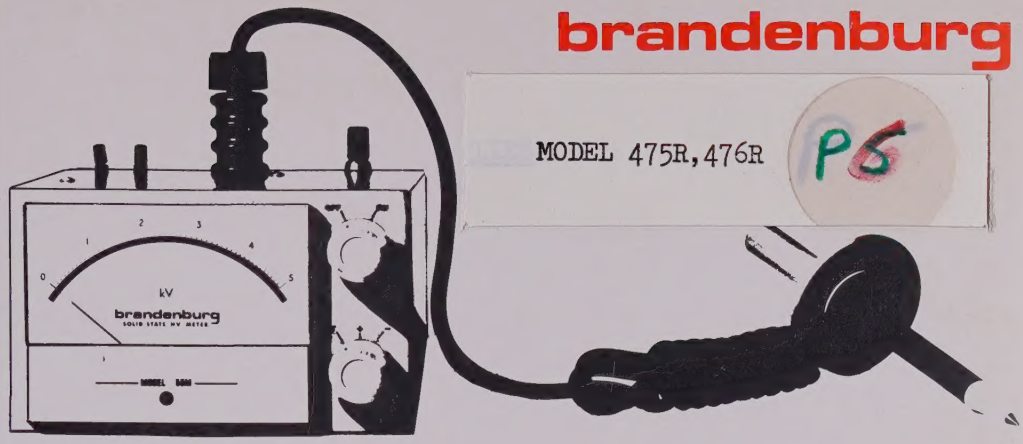
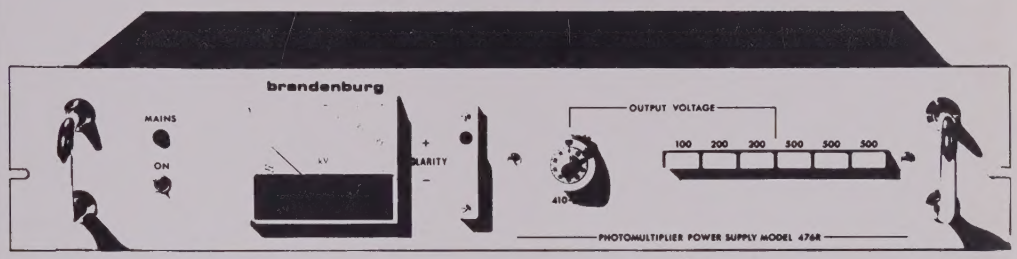
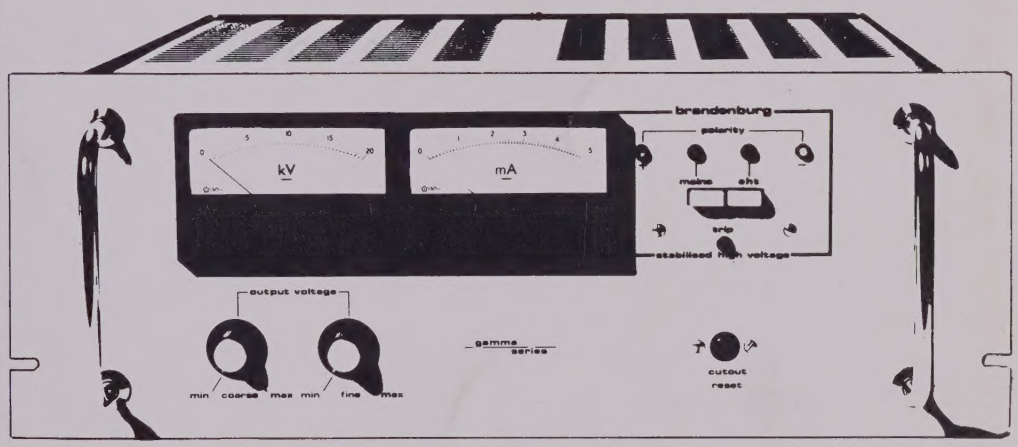
brandenburg

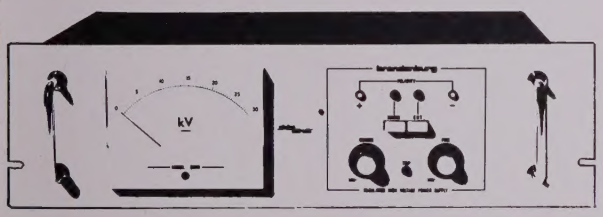
MODEL 475R, 476R P6

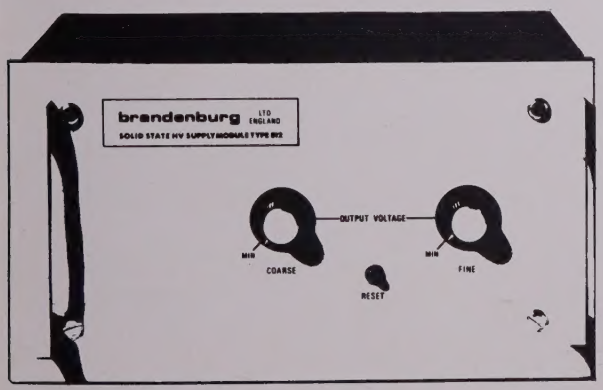


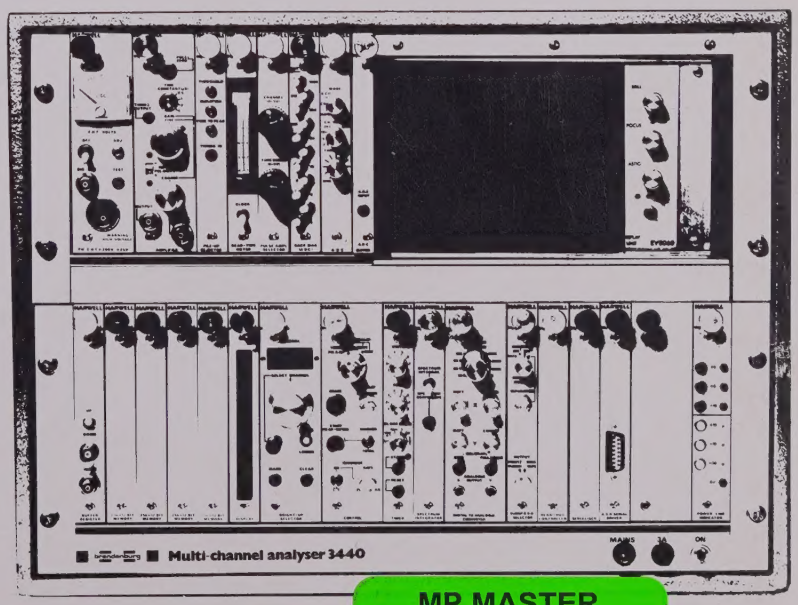












Technical Information

MP MASTER
MA23509

BRANDENBURG LIMITED

PHOTOMULTIPLIER POWER SUPPLIES

MODELS 475R and 476R

BRANDENBURG LIMITED,
939 LONDON ROAD,
THORNTON HEATH,
SURREY CR4 6JE.

Tel: 01-689 0441/5
Telex: 946149

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BRANDENBURG LIMITED

PHOTOMULTIPLIER POWER SUPPLIES

Models 475R & 476R

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Fig.1. Error Amplifier and Feedback Potentiometer

SPARES LIST

475R Circuit Diagram (Drg. No. 475R/2/D)

476R Circuit Diagram (Drg. No. 476R/2/D)

WARNING

EXTREME CAUTION MUST BE EXERCISED WHEN USING THIS EQUIPMENT. THE OUTPUT IS POTENTIALLY LETHAL.

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PHOTOMULTIPLIER POWER SUPPLIES

MODELS 475R and 476R

SPECIFICATION

OUTPUT VOLTAGE:	10V to 2100V (Model 475R) 410V to 2500V (Model 476R)
OUTPUT CURRENT:	5 mA max. (475R). 4 mA max. (476R)
OUTPUT VOLTAGE CONTROL:	Digital push-button and calibrated 10 turn helical potentiometer.
OUTPUT VOLTAGE INDICATION:	2 inch scale length meter.
OUTPUT POLARITY:	Instantly reversible by push-button (a plastic cover is supplied which can be fitted over the polarity push-buttons to prevent accidental reversal).
OUTPUT RIPPLE:	1 mV Peak to Peak.
STABILITY:	1 part in 10^4 against $\pm$ 7½% mains change.
DRIFT	5 parts in 10^5 per hour, 1 part in 10^4 per day.
EFFECTIVE RESISTANCE:	Less than 20 ohms.
PROTECTION:	Mains fuse plus overload cut-out.
FINISH:	Stove-enamelled light grey BS9095 front panel. Case: PVC bonded to aluminium chrome handles.
INPUT:	220/240 volts, 50 Hz. 117 volts, 60 Hz. and other Voltages and Frequencies to special order.
NOTE:	Mains fuse rating is ½ amp for 220/240 volts and 1 amp for 117 volts input.

PRODUCTION CHANGES

In the light of continual development, certain changes to components and improvements to the design may take place. BRANDENBURG LIMITED reserve the right to implement such changes without notice.

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PHOTOMULTIPLIER POWER SUPPLIES

MODELS 475R and 475H

SPECIFICATION

OUTPUT VOLTAGE:	1KV to 2400V (Model 475R) 4KV to 8500V (Model 475H)
OUTPUT CURRENT:	5 ma max. (475R). 4 ma max. (475H)
OUTPUT VOLTAGE CONTROL:	Digital push-button and calibrated 10 turn helical potentiometer.
OUTPUT VOLTAGE INDICATION:	2 inch scale length meter.
OUTPUT POLARITY:	Instantly reversible by push-button (a plastic cover is supplied which can be fitted over the polarity push-buttons to prevent accidental reversal).
OUTPUT RIPPLE:	1 mV Peak to Peak.
STABILITY:	1 part in 10^4 against ± 7½% mains change.
DRIFT:	5 parts in 10^5 per hour, 1 part in 10^4 per day.
RETROTIVE RESISTANCE:	Less than 20 ohms.
PROTECTION:	Mains fuse plus overload cut-out.
FINISH:	Stove-enamelled light grey BS2059 front panel. Cases: ZTO bonded to aluminium chrome handles.
INPUT:	220\240 volts, 50 Hz. 117 volts, 60 Hz. and other Voltages and Frequencies to special order.
NOTE:	Mains fuse rating is ½ amp for 220\240 volts and 1 amp for 117 volts input.

PRODUCTION CHANGES

In the light of continual development, certain changes to components and improvements to the design may take place. BRANDENBURG LIMITED reserve the right to implement such changes without notice.

PHOTOMULTIPLIER SUPPLIES

INSTALLING MODELS 475R and 476R

The compact design of these photomultiplier supplies has been based on a novel concept of a variable high voltage source provided by a special patented transformer coupled to a completely solid state regulator. The high voltage delivered by the transformer automatically adjusts itself at all times to the needs of the series regulater, enabling the regulator to provide the optimum performance at all output voltage settings and load conditions. This technique provides a unique high voltage system that will be found easy to set up for a wide range of photomultiplier tubes. Both models 475R and 476R are equally at home in a standard 19" rack or on the laboratory bench. They can, of course, be used for any purpose for which a 2.1kV 5mA or 2.5kV 4mA power source is suitable.

Transit Packing.

Remove all transit packing and check that the fuse link and output plug are retained (if packed separately).

Connection to Mains Supply

These power supplies operate on 220 to 240 volts 50 Hz supplies and to special order on 117 volts 50 Hz for U.S.A. and Canada etc. Before connecting to the supply, remove the top cover and check that the primary tap is in the right position for your supply.

The power supply is fitted with a three core mains lead and for bench use a three-pin plug must be used. The wires in the mains lead are colour coded and the plug should be connected as follows:-

GREEN/YELLOW LEAD:	EARTH
BLUE LEAD:	NEUTRAL
BROWN LEAD:	LIVE

For installation in a rack the leads can be connected to the terminal block providing the mains take-off point for other services in the rack, or the power supply can be independently connected by means of a plug. If the power supply is the only mains driven apparatus housed in the rack, then it is recommended that the chassis of the power unit be bonded to the rack by connecting the earth terminal provided at the rear of the power supply unit. Ensure that the fuse is fitted in the holder at the rear and that it is the correct type (See Specification).

cont'd .. ..

INSTALLING MODELS 475R and 476R (cont'd).

Load Connection

Both models are provided with a high voltage co-axial output socket to which you may fit a screened high voltage lead (Uniradio 70 or equivalent) for connecting to the dynode chain or other load. For trouble-free operation, it cannot be over-emphasised that extreme care should be taken in making a sound earth connection from the load to the power supply. This should be as direct as possible, avoiding shared "loops" with other apparatus which may induce circulating currents in the return lead. Failure to observe this precaution may superimpose undersirable ripple and noise on the output of the power supply. On no account should the low potential connection be made to any point on the supply other than the terminals provided. To preclude any possibility of corona discharge the high voltage connection should be free from spikes and sharp edges, both at the power supply terminal and the terminal of your load.

USING THE MODELS 475R and 476R

FRONT PANEL LAYOUT AND CONTROLS (See Drawing on Page 8)

ON - OFF

Both models are ready the instant you switch on. A mains indicator light is provided.

POLARITY SWITCH

Select the polarity you require by pressing the appropriate button:

RED - Positive output with respect to ground

BLACK - Negative output with respect to ground.

Avoid changing the polarity with the Mains Switch on if the total capacitance of the load exceeds 0.1uf.

NOTE: A plastic cover is supplied which can be screwed into position over the 2 polarity change switch buttons to prevent accidental change of polarity.

OUTPUT VOLTAGE SELECTION (Coarse and Fine Controls)

Selecting the output voltage for your load is simplicity itself; a calibrated fine control and six push buttons enable you to cover the full range repeatedly with ease.
Each of the six push buttons comprising the coarse voltage control will raise the output when pushed in, the output increasing by an amount equal to the figure denoted above the button. To lower the output, the button is simply released by applying light pressure. The output voltage is equal to the sum of the pre-set voltages. selected plus the reading indicated by the fine control.

For example :-

FINE CONTROL	SELECTED BUTTONS						TOTAL OUTPUT
Volts	100	200	200	500	500	500	Volts
10							10
20	X	X					320
100		X	X	X			1000
100	X	X	X	X	X	X	2100

The above example applies to model 475R. The same principle applies to model 476R, except that the minimum voltage is 410 volts and not 10 volts.

Of course, you may depress the voltage selector buttons in any order whilst the power unit is on load, but take care not to apply an excessive voltage to your load or the current capacity of the power supply may be exceeded. When this happens the terminal voltage will begin to fall back, as indicated by the built-in monitor volt-meter. Use the meter to double check your selected voltage and if there is a marked discrepancy, it may be due to overload.

USING THE MODELS 475R and 476R (cont'd).

PUSH-BUTTON INTERLOCK

In order to limit the output voltage should you wish to do so, an interlocking device has been incorporated in the rear of the push-button assembly. This device enables you to lock off any or all of the push-buttons.

SETTING OF PUSH-BUTTON INTERLOCK

Disconnect power supply unit from mains. Access to the interlock is gained by removing the two screws securing the top cover and sliding off the cover. This will expose the switch bank. At the rear of the switches you will notice a row of 6 x 6BA cheese-headed screws with lock nuts (see drawing on page 8). In order to stop off a button the lock nuts should be freed and the screw screwed in until its end protrudes beneath the lock bar and prevents the blade of the appropriate switch from moving. Tighten up lock nut. Replace cover.

OVERLOAD PROTECTION

Your model 475R (or 476R) is fully protected against accidental overload by an auxiliary circuit that comes into use whenever the output current exceeds 5mA (Model 475R) or 4mA (Model 476R). It is fully automatic and does not need to be re-set, full output voltage being restored immediately the overload is removed. Therefore, a transient overload need not interrupt your work with the consequent re-set procedure necessary with a trip system.

Under severe overload conditions the terminal voltage will fall back, as indicated on the meter, until the output current has been limited to approximately 7mA on model 475R and 6mA on model 476R. These figures will not be exceeded even under short-circuit conditions and are not dependent on the intial voltage settings.

MODELS 475R and 476R

CIRCUIT DESCRIPTION

GENERAL

The model 475R and model 476R circuits include two separate regulating loops :-

(a) A fast regulator controlling the output line volts in response to an error signal derived from a feed-back potentiometer connected between the output terminals. The output regulator employs a conventional series pass element and drive amplifier.

(b) A pre-regulator which holds the voltage developed across the series pass element within its working range during all conditions of output loading. The pre-regulator is integral with the high impedance transformer T.1. and emulates a shunt regulator controlling the high voltage supply to the pass element.

The output voltage setting within the working range of both models is determined by changing the resistance value of one arm of the feed-back potentiometer. The low potential end of the divider is fixed and the voltage developed across it is compared with a zener reference voltage at the error amplifier input.

The amplifier, reference and associated low voltage rails are isolated to withstand the full output voltage of 2.1kV (2.5kV) so that either pole of the E.H.T. may be grounded through the reversed switch. The monitor voltmeter is kept at ground potential and the meter polarity is reversed by switching diodes.

ERROR AMPLIFIER AND FEEDBACK POTENTIOMETER

The function of the fast regulator circuit may be better understood by referring to the simplified schematic shown in Fig. 1 in which the components of the ballast chain, overload circuit and compensating network have been omitted for the sake of clarity.

Thus, the active elements of the error amplifier consist of the balanced pair VT6 and VT7 feeding an emitter follower VT10, which in turn drives the high gain cascode couple formed by VT9 and the pass element VT8.

The zener regulator diode chain Z1 and Z2 hold the amplifier supply rail at 4.7 volts positive and 22 volts negative with respect to the H.V. positive output line. In addition to providing a collector supply rail for the error amplified which is a few volts positive to the emitter of VT9, Z1 also acts as a reference voltage source for the pre-regulator (See Pre-regulator).

Temperature compensated diodes Z3/Z4 provide the stable reference voltage (pre-set by adjustment of RV3) to the error amplifier. At the input of the error amplifier a fraction of the high voltage appearing across the feed-back potentiometer is compared with reference voltage. Any error in the two voltages is amplified by the high gain direct coupled amplifier and applied to the base of VT9 which then regulates the flow of current from the H.V. power unit to minimise the error.

cont'd .. ..

MODELS 475R and 476R

CIRCUIT DESCRIPTION (cont'd)

ERROR AMPLIFIER AND FEEDBACK POTENTIOMETER (Cont'd)

The output voltage level is set by adjustment of one arm of the feedback potentiometer. Since the sensing resistor R29 is fixed and the mean current through it constant, then the output voltage level is a linear function of the resistance value of the adjustable arm. In the model 475R (476R) the resistance change of the adjustable arm is 1000 ohms/volt.

In describing briefly the function of the fast regulator, no mention has been made of the voltage finally developed across the pass element, but it will be evident that when the stabilised output voltage is set at the lower level, some steps must be taken to limit the corresponding rise of voltage across VT8 and VT9. Since the base of VT8 is tied via Z1 to the emitter of VT9, the collector/emitter voltage of VT9 cannot rise above some 4.7volts, at which point VT8 will be rapidly driven to cut-off. Therefore, the major change of voltage appearing across the pass element is across VT8. The voltage rating of this transistor is sufficiently large to buffer the effects of load change and ripple, but use is made of a pre-regulator to keep the mean voltage level well within the rating of VT8.

PRE-REGULATOR

The model 475R (476R) pre-regulator is designed around a specially constructed high reactance transformer, (provisional Patent No. 4972/69 - U.S. Patent No. 3636433) which forms the basis of a shunt type regulator. The transformer is shown as T.1 on the circuit diagram and is wound with three separate secondaries. Secondary 1 is closely coupled with the primary and provides an un regulated supply to the 300V auxiliary line after rectification and smoothing (D9-C6-R13-C7). Secondary 2 and Secondary 3 are loosely coupled to the primary and are wound on a long magnetic loop. A magnetic shunt limits the energy available in these windings which have a high impedance characteristic.

Secondary 2, the control winding, works into a shunt load comprising VT5 driven by emitter follower VT4.

The bridge rectifier D1-D4 ensures conduction of the transistors on each half cycle.

Secondary 3, the high voltage winding, provides the pre-regulated supply to the line regulator after rectification and smoothing:
R10 limits the surge current from the filter capacitors C4 and C5 during overload conditions.

In operation the transformer functions in a see-saw fashion. The highest voltage output at full load is available from the E.H.T. winding (Secondary 3) when the control winding current is at its lowest and, conversely when minimum current is being drawn from the E.H.T winding at the low voltage setting most of the energy available in the secondary loop will be drawn from the control winding (Secondary 2) and dissipated across VT5. The drive to VT5 is made to vary according to the needs of the high voltage circuit by feeding a fraction of the voltage developed across VT8 from the potentiometer R12/RV1 (see figure 1) to the compound emitter follower VT1/VT2/VT3 and thence to VT4/VT5. The pre-regulator stabilises the potential developed across the pass element to a mean level of 130V in both models 475R and 476R.

CIRCUIT DESCRIPTION (cont'd)

PRE-REGULATOR (cont'd)

The mean voltage across VT8 is set by adjustment of RV1. The phase shift network R14/C8 across RV1 prevents shunting in the pre-regulator. Diode D10 conducts to clip transient surges when its anode voltage exceeds that of the 300V auxiliary rail.

The square voltage waveform appearing across the H.V. secondary is a product of the high reactance winding, the capacitive filter network. To produce a compatible load characteristic in VT5, the capacitor/resistor network C2/R1 has been added.

OVERLOAD PROTECTION

The principal elements of the overload sensing circuit in models 475R and 476R consist of VT11 and D11, both of which conduct to by-pass the base current drive to VT10 when the currents drawn from the power supply exceeds 5 mA in model 475R and 4 mA in model 476R. When VT11 is fully on, the output current from the power supply is limited to 7 mA on model 475R and 6 mA on Model 476R nominal in a short circuit.

An output current of 5mA or less flowing through the current sensing resistors RV2-R25-RV4 will develop a sufficiently large potential to drive VT11 into conduction and in this state the collector potential of VT11 rises to a level exceeding that at the base of VT10. Diode D11 is thus reversed biased, preventing the overload circuit from damping the error amplifier at normal loading.

The overload level is pre-set by adjustment of the internal potentiometer RV2.

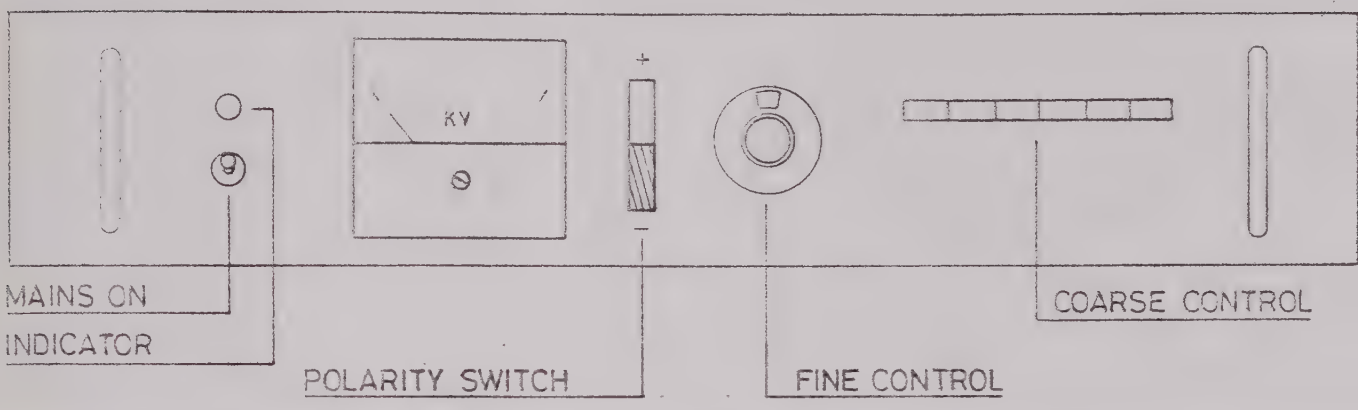
BALLAST LOAD

To overcome the effects of the non-linearity by the pre-regulator at the lower voltage settings, when the saturation of VT5 and the bridge rectifier prevent the control winding voltage from falling any further, a graded ballast resistor is incorporated which increases the standing load on the E.H.T. windings as the output voltage setting is decreased. The group comprises R61, VT12 and R44 to R49 inclusive. The ballast load is returned to the positive rail at a point such that the standing load does not influence the setting of the overload trip. The shorting switches are ganged to the feed-back potentiometer controls.

COMPENSATING FEEDBACK

The output imedance characteristic of the power supply is further improved by returning the feedback potentiometer to the positive output rail via RV4 so that a small potential which increases with increasing load current is introduced into the feedback system in such a direction as to lower the output impedance of the supply.

FRONT PANEL LAYOUT AND CONTROLS



PUSH BUTTON LOCKING SYSTEM.

ERROR AMPLIFIER AND FEEDBACK POTENTIOMETER.

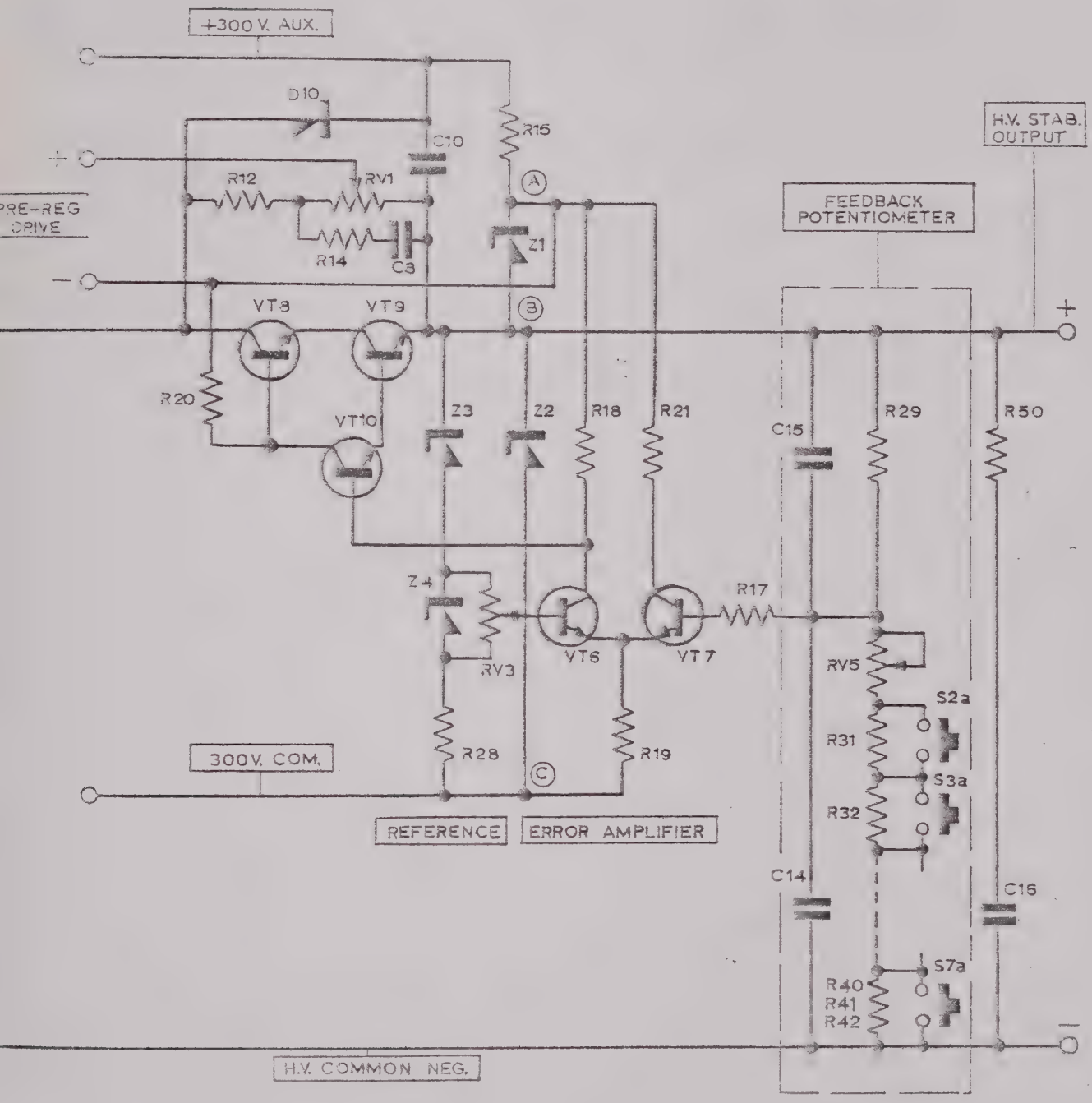


FIG. 1.

NOTE POINT (A) IS 4·7V POSITIVE WITH RESPECT TO (B)

AND POINT (C) IS 22V NEGATIVE WITH RESPECT TO (B)

BRANDENBURG LIMITED

Models 475R & 476R

SPARE PARTS LIST

CIRCUIT REF	NO OFF	DESCRIPTION		VALUE	SUPPLIER	TYPE NO
All resistors in this manual are 2% tolerance and $\frac{1}{4}$w rating unless otherwise stated.						
		AMPLIFIER PC 475/1				
R4	1	Resistor		100ohm $\frac{1}{2}$w	Electrosil	TR5
R6	1	"		4.7K "	"	"
R7	1	"		100K "	"	"
R8	1	"		680K "	"	"
R9	1	"		22K "	"	"
R11	1	"		470K "	"	"
R12	1	"		22K "	"	"
R13	1	"		2.2K "	"	"
R14	1	"		10K "	"	"
R15	1	"	5% tol	22K 6w	"	RFH3-6
R16	1	"		1.5K	"	TR5
R17	1	"		10K	"	TR5
R18	1	"		68K	"	"
R19	1	"		100K	"	"
R20	1	"		10K	"	"
R21	1	"		68K	"	"
R22	1	"		2.2K	"	"
R23	1	"	$\pm$ .5 ohm	4.7ohm	Morgan	S
R24	1	"		2.2K	Electrosil	TR5
R25	1	"		68ohm	"	"
R26	1	"		100ohm	"	"
R27	1	"	5% tol	4.7K 6w	Dub	RFH3-6
R28	1	"		1.5K	Electrosil	TR5
R29	1	"	1% tol	10K	Allen Bradley	FC55
C1	1	Capacitor	Wkg Volts 2500	0.02µf	Erie	K8/000/11/CP4
C6	1	"	" " 400	15µf	Erie	211
C7	1	"	" " 350	16µF	Hunts	JF405AT
C8	1	"	" " 35	3.3µF	STC	TAG3.3/35

BRANDENBURG LIMITED

Models 475R & 476R

SPARE PARTS LIST

CIRCUIT REF	NO OFF	DESCRIPTION	VALUE	SUPPLIER	TYPE NO.
		AMPLIFIER 475R/1 (Cont'd)			
C9	1	Capacitor Wkg volts 63	47µF	Erie	20103-100-Q470-0T-0630
C10	1	" " " 10	470µF	Waycom	Printilyt
C11	1	" " " 250	0.022µF	Mullard	C281VV/A22/K
C12	1	" " " 6.3	220µF	Erie	20101-100-0221-0T-0639
C13	1	" " " 25	22µF	Mullard	015-16229
C15	1	" " " 400	0.047	I.T.T.	50104-000-0503-0M-0351
D9	1	Diode		S.T.C.	RAS310AF
D10	1	"		S.T.C.	RAS310AF
D11	1	"		Mullard	BAX16
D14	1	" (Model 475R)		"	"
D15	1	"		S.T.C.	RAS310AF
RV1	1	Potentiometer	22K	Plessey	MPD
RV2	1	"	100ohm	"	WMP/100
RV3	1	"	5K	Daystrom	530-00HS
Rv4	1	"	5ohm	Colvern	PC1/1/P
RV5	1	" Tol -0+3%	102K	Spectrol Reliance	534
VT1	1	Transistors		Ferranti	ZTX 300
VT2	1	"		Ferranti	ZTX 300
VT3	1	"		Ferranti	ZTX 300
VT6	1	"		Jermyn	BFR16 (PAD-TO18-010)
VT7	1	"		"	"
VT8	1	"		Motorola	MJE340
VT9	1	"		Ferranti	ZTX 300
VT10	1	"		Ferranti	ZTX 300
VT11	1	"		Ferranti	ZTX 300
VT12	1	" (Model 475R)		Motorola	MPSA92
Z1	1	Zener Diode		Mullard	BZY88 C4V7
Z2	1	" "		"	BZY95 C22
Z3	1	" "		Motorola Dickson	IN821

BRANDENBURG LIMITED

Models 475R & 476R

SPARE PARTS LIST

CIRCUIT REF	NO OFF	DESCRIPTION	VALUE	SUPPLIER	TYPE NO
		AMPLIFIER 475R/1 Cont'd			
Z4	1	Zener Diode		Motorola Dickson	IN821
Z5	1	" " (Model 475R)		I.T.T.	ZY120
	1	475R/1 P.C. Board Assy Complete		Brandenburg	
		475R/2 ASSEMBLY			
R60	1	Resistor	100K ½w	Electrosil	TR5
R61	1	" (Model 475R)	8.2K	"	"
R61	1	" (Model 476R)	100K	"	"
R62	1	" (Model 475R)	200K	"	"
R63	1	" (Model 475R)	220K	"	"
R64	1	"	2.2K	"	"
R66	1	" (Model 476R) 1% tol	200K	Resolute	RC65
R67	1	" (Model 476R) 1% tol	200K	"	"
R68	1	" (Model 476R) 5% tol	2M	Mullard	VR37
R70	1	" (Model 476R) 5% tol	3.9M ½w	"	VR37
D5	1	E.H.T. Rectifier		Westinghouse Brake	K238EL100
D6	1	" "		"	"
D7	1	" "		"	"
D8	1	" "		"	"
R3		Resistor 10% tol	10K	Electrosil	TR6
R10		" 10% tol	10K	"	"
C3		Capacitor Wkg volts 3kV	0.1	Suflex	SN114
C4		" " " 3kV	0.1	"	"
C5		" " " 3kV	0.1	"	"
	1	472R/2 P.C. Board Assembly complete		Brandenburg	

BRANDENBURG LIMITED

Models 475R & 476R

SPARE PARTS LIST

CIRCUIT REF	NO OFF	DESCRIPTION	VALUE	SUPPLIER	TYPE NO
		475R/3 ASSEMBLY			
R30	1	Resistor 50PPM	68ohm ½w	Electrosil	TR5
R31	1	" metal film 1% tol "	100K	Resolute	RC65
R32	1	" metal film 1% tol "	200K	"	"
R33	1	" metal film 1% tol "	200K	"	"
R34	1	" metal film 1% tol "	100K	"	"
R35	1	" metal film 1% tol "	200K	"	"
R36	1	" metal film 1% tol "	200K	"	"
R37	1	" metal film 1% tol "	100K	"	"
R38	1	" metal film 1% tol "	200K	"	"
R39	1	" metal film 1% tol "	200K	"	"
R40	1	" " " " " "	100K	"	"
R41	1	" " " " " "	200K	"	"
R42	1	" " " " " "	200K	"	"
R50	1	Resistor	10ohm ½w	Electrosil	TR5
R51	1	"	A.O.T.	"	"
R52	1	" 5% tol	9.1M ½w	Mullard	VR37
R53	1	" " "	9.1M ½w	"	"
R54	1	" " "	1.5M ½w	"	"
R55	1	"	1M	Electrosil	TR5
R56	1	"	1M	"	"
	1	475R/3 P.C. Board Assembly Complete		Brandenburg	
D12	1	Diode		Mullard	BAX16
D13	1	"		"	"
C14	1	Capacitor wkg volts 3kV	0.05	Suflex	SN 1113
C16	1	" wkg volts 3kV	0.1	"	SN 1114

BRANDENBURG LIMITED

MODELS 475R & 476R

SPARE PARTS LIST

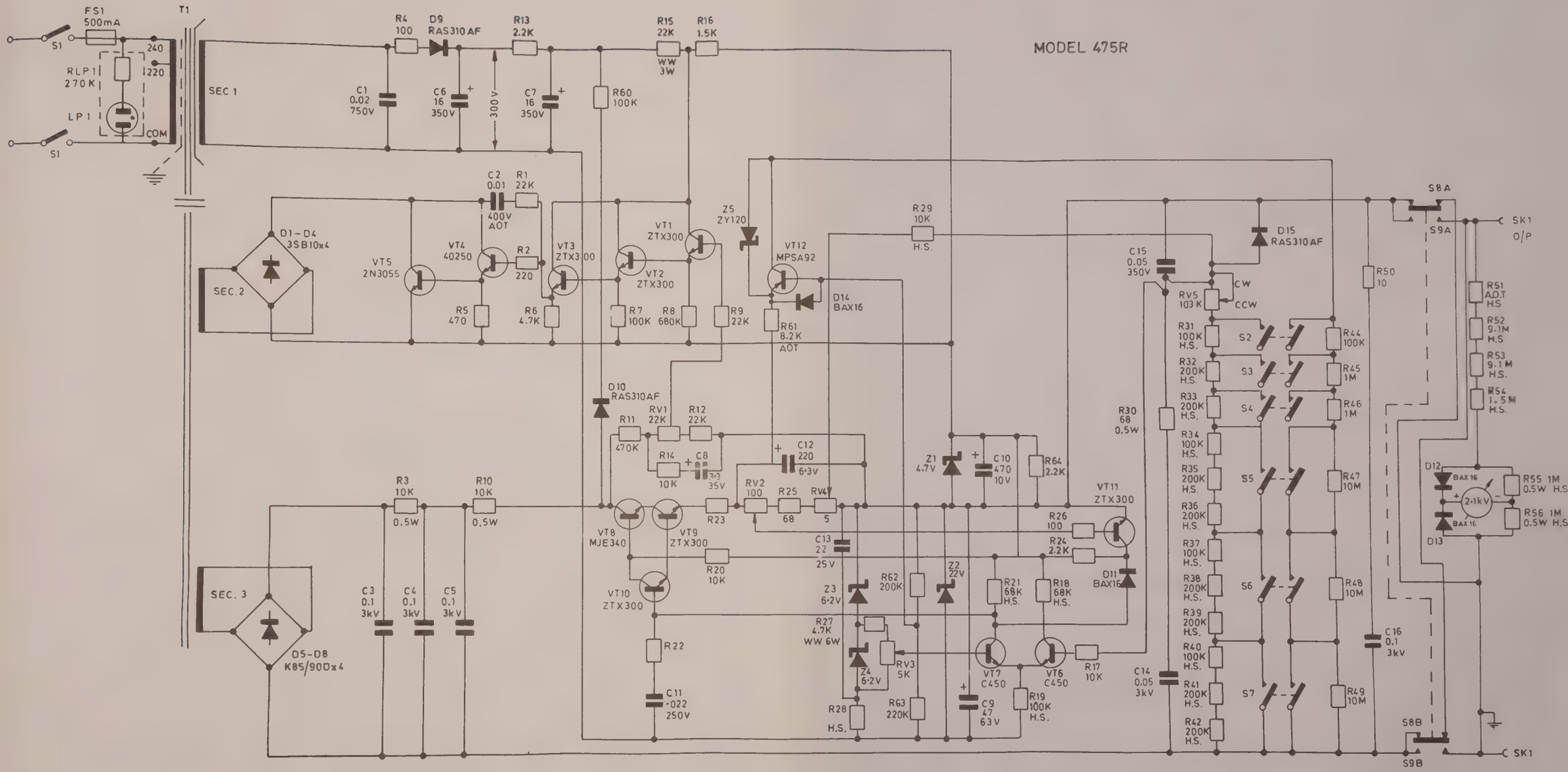
CIRCUIT REF	NO OFF	DESCRIPTION	VALUE	SUPPLIER	TYPE NO.
		SWITCH ASSEMBLY			
R44	1	Resistor (Model 475R)	100K	Electrosil	TR5
R44	1	" (Model 476R)	1M	Mullard	VR37
R45	1	" 5% tol	1M	Mullard	VR37
R46	1	" " "	1M	"	"
R47	1	" " "	10M	"	"
R48	1	" " "	10M	"	"
R49	1	" " "	10M	"	"
S2-S7	1	6 Bank Push Button Switch Independant Action Push Off		A.B.M.	T.700 6QS/ 1106
S8-S9	1	2 Bank Push Button Switch Assembly Interdependant Action		A.B.M.	700 2QS/ 1107
		HEATSINK ASSEMBLY			
D1-D4	1	Bridge Rectifier		I.R.C.	3SB10
VT4	1	Transistor		R.C.A.	40250
VT5	1	"		R.C.A. or Motorola	2N3055
R1	1	Resistor	22K	Electrosil	TR5
R2	1	"	220ohm	"	"
R5	1	"	470ohm	"	"
C2	1	Capacitor wkg volts 400	0.01uF	S.T.C.	PMT2R0.01M 400

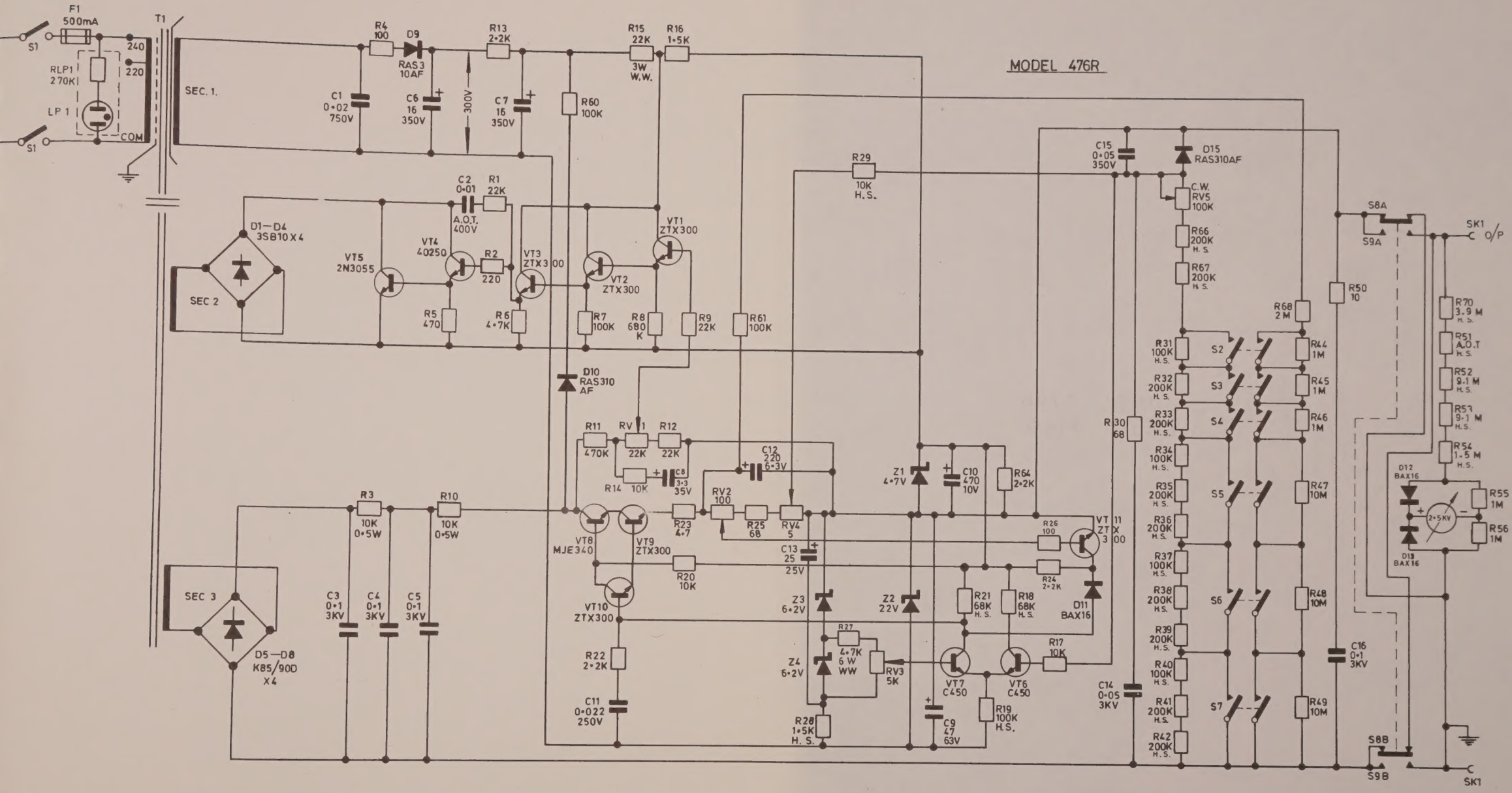
BRANDENBURG LIMITED

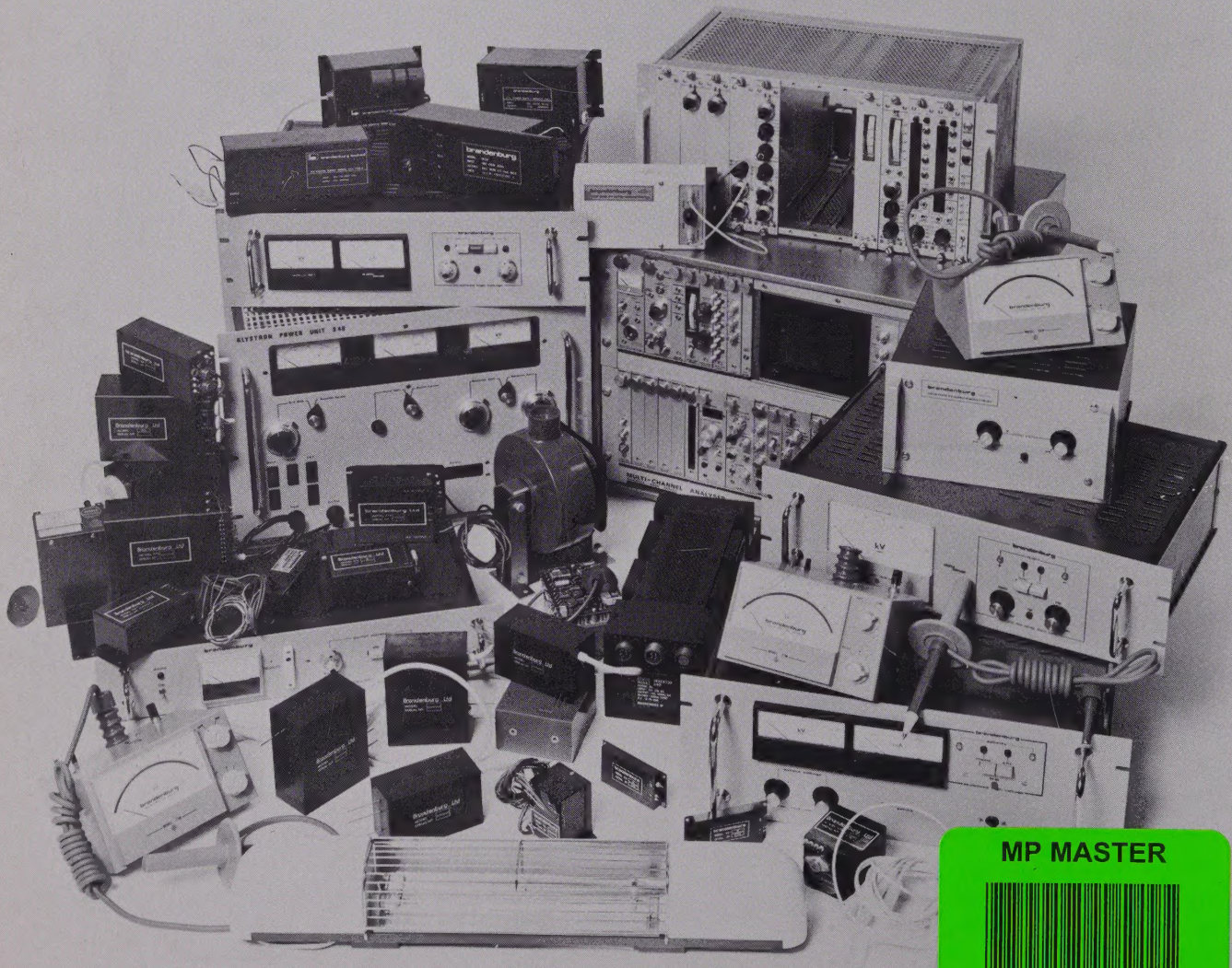
Models 475R & 476R

SPARE PARTS LIST

CIRCUIT REF	NO OFF	DESCRIPTION	VALUE	SUPPLIER	TYPE NO.
		MISCELLANEOUS			
M1	1	K.V. Meter Clearfront 100uA F.S.D. Scaled 0-2.1kV Black (Model 475R)		Sifam	M22
M1	1	K.V. Meter Clearfront 100uA F.S.D. Scaled 0-2.5kV Black (Model 476R)		Sifam	M22
LP1	1	Miniature Neon Lamp Red		Osmor Plastics	250/1
RLP1	1	Resistor	270K	Electrosil	TR5
S1	1	Mains Switch		Arrow	CTS6
T1	1	Transformer		Brandenburg	101
F1	1	Fuse 500MA		Bulgin	F286
PL1	1	Plug (Free) High voltage MHV B.N.C.		Amphenol	UG-932/U 28000
SK1	1	Socket (Fixed) High voltage MHV B.N.C.		"	UG-931/U 27000
1	1	Earth Terminal Black		Belling	LI568/IE.06


MODEL 475R
FS1
500mA
T1
S1
240
220
COM
RLP1
270K
LP1
SEC 1
R4
100
D9
RAS310AF
R13
2.2K
R15
22K
WW
3W
R16
1.5K
C1
0.02
750V
C6
16
350V
300 V
C7
16
350V
R60
100K
C2
0.01
400V
AOT
R1
22K
D1-D4
3SB10x4
SEC.2
VT4
40250
VT5
2N3055
R2
220
VT3
ZTX300
VT1
ZTX300
VT2
ZTX300
R5
470
R6
4.7K
R7
100K
R8
680K
R9
22K
Z5
ZY120
VT12
MPSA92
D14
BAX16
R61
8.2K
AOT
R29
10K
H.S.
D10
RAS310AF
R11
470K
RV1
22K
R12
22K
R14
10K
C8
3·3
35V
C12
220
6·3V
R3
10K
0.5W
R10
10K
0.5W
SEC. 3
D5-D8
K85/90Dx4
C3
0.1
3kV
C4
0.1
3kV
C5
0.1
3kV
VT8
MJE340
VT9
ZTX300
VT10
ZTX300
R23
RV2
100
R25
68
RV4
5
R20
10K
C13
22
25V
R22
C11
·022
250V
Z3
6·2V
R27
4.7K
WW 6W
Z4
6·2V
RV3
5K
R28
H.S.
R62
200K
Z2
22V
R63
220K
Z1
4.7V
C10
470
10V
C9
47
63V
R64
2.2K
R21
68K
H.S.
R18
68K
H.S.
R19
100K
H.S.
VT11
ZTX300
R26
100
R24
2.2K
D11
BAX16
VT7
C450
VT6
C450
R17
10K
R30
68
0.5W
C14
0.05
3kV
C15
0.05
350V
D15
RAS310AF
CW
CCW
RV5
103K
R31
100K
H.S.
R32
200K
H.S.
R33
200K
H.S.
R34
100K
H.S.
R35
200K
H.S.
R36
200K
H.S.
R37
100K
H.S.
R38
200K
H.S.
R39
200K
H.S.
R40
100K
H.S.
R41
200K
H.S.
R42
200K
H.S.
S2
S3
S4
S5
S6
S7
R44
100K
R45
1M
R46
1M
R47
10M
R48
10M
R49
10M
R50
10
C16
0.1
3kV
S8A
S9A
S8B
S9B
SK1
O/P
SK1
R51
A.D.T
H.S
R52
9·1M
H.S
R53
9·1M
H.S.
R54
1·5M
H.S.
D12
BAX16
D13
BAX16
2·1kV
R55 1M
0.5W H.S
R56 1M
0.5W H.S


MODEL 476R
F1
500mA
T1
S1
240
220
COM
RLP1
270K
LP 1
SEC. 1.
SEC 2
SEC 3
D1—D4
3SB10X4
D5—D8
K85/900
X4
R4
100
D9
RAS3
10AF
R13
2·2K
R15
22K
3W
W.W.
R16
1·5K
C1
0·02
750V
C6
16
350V
300V
C7
16
350V
R60
100K
C2
0·01
A.O.T.
400V
R1
22K
VT1
ZTX300
VT2
ZTX300
VT3
ZTX300
VT4
40250
VT5
2N3055
R2
220
R5
470
R6
4·7K
R7
100K
R8
680
K
R9
22K
R61
100K
R29
10K
H.S.
D10
RAS310
AF
R11
470K
RV1
22K
R12
22K
R14
10K
C8
3·3
35V
C12
220
6·3V
RV2
100
R25
68
RV4
5
R23
4·7
R20
10K
VT8
MJE340
VT9
ZTX300
VT10
ZTX300
R22
2·2K
C11
0·022
250V
R3
10K
0·5W
R10
10K
0·5W
C3
0·1
3KV
C4
0·1
3KV
C5
0·1
3KV
C13
25
25V
Z3
6·2V
Z4
6·2V
R27
4·7K
6 W
WW
RV3
5K
R28
1·5K
H. S.
Z1
4·7V
Z2
22V
C10
470
10V
R64
2·2K
R26
100
R24
2·2K
VT11
ZTX300
D11
BAX16
R21
68K
H.S.
R18
68K
H.S.
R17
10K
VT7
C450
VT6
C450
C9
47
63V
R19
100K
H.S.
C14
0·05
3KV
C15
0·05
350V
D15
RAS310AF
C.W.
RV5
100K
R66
200K
H.S.
R67
200K
H.S.
R68
2M
R30
68
R50
10
R31
100K
H.S.
R32
200K
H.S.
R33
200K
H.S.
R34
100K
H.S.
R35
200K
H.S.
R36
200K
H.S.
R37
100K
H.S.
R38
200K
H.S.
R39
200K
H.S.
R40
100K
H.S.
R41
200K
H.S.
R42
200K
H.S.
S2
S3
S4
S5
S6
S7
R44
1M
R45
1M
R46
1M
R47
10M
R48
10M
R49
10M
C16
0·1
3KV
S8A
S9A
S8B
S9B
SK1
O/P
SK1
R70
3·9 M
H.S.
R51
A.O.T
H.S.
R52
9·1 M
H.S.
R53
9·1 M
H.S.
R54
1·5 M
H.S.
D12
BAX16
D13
BAX16
2·5KV
R55
1M
R56
1M



MP MASTER
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brandenburg

Brandenburg Limited, 939 London Road, Thornton Heath, Surrey CR4 6JE. Telephone: 01-689 0441 Telex: 946149.